FIDS 88-6

Forest Insect and Disease Conditions

Vancouver Forest Region
1987

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VANCOUVER MAINLAND
AND
VANCOUVER ISLAND

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APPENDICES

The following reports summarizing pest activities or projects undertaken during the course of the year can be obtained upon request from the **Pacific Forestry Centre, Canadian Forestry Service, 506 West Burnside Road, Victoria, B.C. V8Z 1M5 (Tel. 388-0600).** Additional copies of this report and copies of other publications such as provincial and national pest survey overviews, forest pest leaflets, and regional forest pest histories are also available.

Canadian Forestry Service, Forest Insect and Disease Survey, Seed Orchard Examination Report Summary - 1987. R.L. Ferris.

Forest Pest Conditions in Pacific Rim National Park, 1987. R.L. Ferris.

Forest Pest Conditions on the Gulf Islands, 1987. R.L. Ferris.

Pest Conditions at Mt. Maxwell Eco Reserve, 1987. R.L. Ferris.

Forest Pest Conditions at Carnation Creek, 1987. R.L. Ferris.

Forest Pest Conditions at Shawnigan Experimental Plots, 1987. R.L. Ferris.

Forest Pest Conditions in the Green Mountain Experimental Site, 1987. R.L. Ferris.

Forest Pest Conditions in the Mill Bay Tree Farm, 1987. R.L. Ferris.

Aerial Survey with Macmillan Bloedel Ltd., 1987. R.L. Ferris.

Status of Forest Pests in Provincial Parks in the Vancouver Forest Region, 1987. C. Wood.

Status of Forest Pests in the Vancouver Watersheds, 1987. N. Humphreys.

INTRODUCTION

This report outlines the status of forest pest conditions in the Vancouver Forest Region for 1987 and forecasts population trends of some potentially damaging pests. Pests are listed by host in order of importance.

The Forest Insect and Disease Survey (FIDS) is a nationwide network within the Canadian Forestry Service (CFS) with the responsibility of producing an overview of forest pest conditions and their implications; maintaining records and surveys to support quarantines and facilitate predictions; supporting forestry research with records, herbaria and insect collections; providing advice on forest insect and disease conditions; and developing and testing survey techniques and conducting related biological studies.

The Queen Charlotte Islands were surveyed by Prince Rupert FIDS rangers Leo Unger and Al Stewart, and the information is compiled in a separate section of the report. The insect and disease data from the Mid-Coast forest district was collected by Dick Andrews, the Cariboo FIDS ranger.

The forest pest survey field season extended from mid-May to early October. A total of 433 insect and 137 disease collections were submitted to Pacific Forestry Centre by FIDS survey personnel. Map 1 shows the locations where one or more samples were collected and the areas covered by 32 hours of fixed-wing aircraft surveys and 2 hours of helicopter surveys. A total of 114 special collections included spruce budworm parasites, pine needle sheathminer, white pine blister rust spores, tent caterpillar and diseases and insects of weed species.

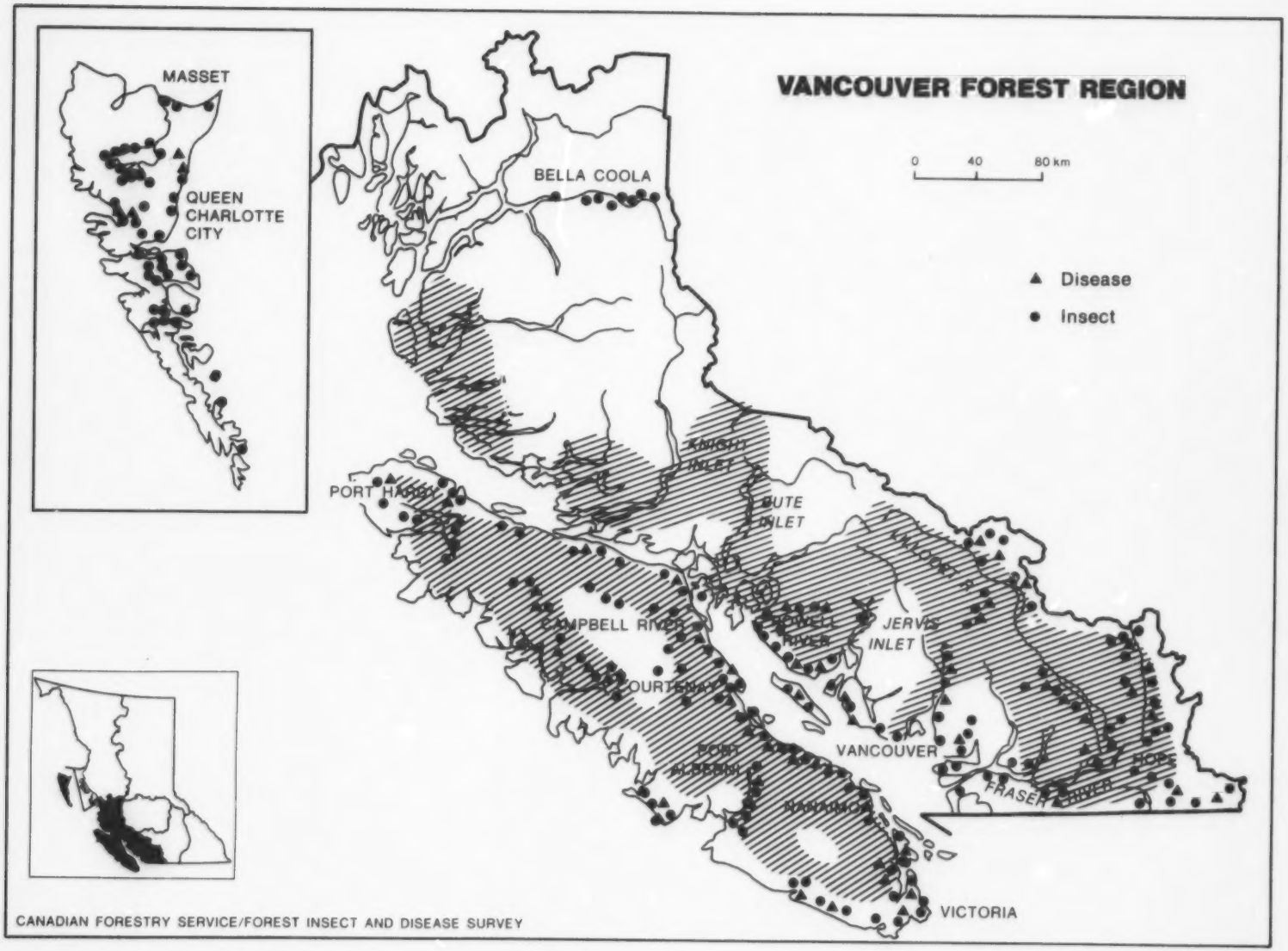
Surveys on the Queen Charlotte Islands were conducted from July 13 to 23 and September 30 to October 6. Ten disease and 149 insect samples were collected. Approximately 42 contacts and on-site pest examinations were made with B.C. Forest Service and industry personnel.

Numerous special surveys were conducted including: pinewood nematode, inspections of provincial parks and seed orchards; acid rain plot monitoring, spruce budworm and gypsy moth pheromone trapping, balsam woolly adelgid surveys, young stand surveys, and fume damage plot assessment.

Personnel of the B.C. Forest Service, Crown Forest Ltd., MacMillan Bloedel Ltd., and Western Forest Products Ltd. assisted with marine and air transportation, provided aerial sketchmaps of defoliation, assisted with defoliator larval and egg sampling and accommodation.

Defoliation intensities in the report are defined as follows:

Trace - evidence of feeding barely detectable close up
Light - some branch and/or upper crown defoliation, barely visible from the air
Moderate - pronounced discoloration and noticeably thin foliage, severe top defoliation common
Severe - top + many branches completely defoliated, most trees more than 50% defoliated



Map 1. Areas where one or more forest insect and disease samples were collected and area covered by aerial surveys to map bark beetles and defoliator infestations, 1987

SUMMARY

Western spruce budworm lightly to moderately defoliated Douglas-fir over 2850 ha in the Gates River-Blackwater Creek area, up from 1255 ha in 1986. For the third consecutive year **Douglas-fir beetle** attacks decreased, infesting trees over 42 ha.

Mountain pine beetle killed an estimated 55 500 lodgepole pine over 1470 ha in the Soo, Quadra and Fraser Timber Supply Areas, a major decline from 126 850 trees killed in 1986. Incidence of **pine engraver beetles** also decreased in trees attacked by mountain pine beetle in the Birkenhead Lake area. **Pine needle sheathminer** defoliated immature pine over 155 ha at six locations in the region.

The **blackheaded budworm-hemlock sawfly** infestation continued on the Queen Charlotte Islands over 14 110 ha, down from 44 300 ha in 1986. A new **blackheaded budworm** infestation covering 5 ha was recorded near Holberg on Vancouver Island. **Western hemlock looper** caused light to severe defoliation of western hemlock, western red cedar and broadleaf maple on the west side of Jervis Inlet. Understory regeneration of mountain hemlock on a ridge southeast of Juskatla was damaged by **Sirococcus tip blight**, a new host record for this disease.

Balsam bark beetle killed 10 450 alpine fir throughout the region, down from 14 700 trees in 1986. **Balsam woolly adelgid** was recently collected from outside the infestation zone, resulting in increased surveys for this pest.

Spruce beetle populations decreased and no new infestations were mapped in 1987. **Spruce aphid** defoliated native and ornamental spruce at various sites throughout the Vancouver Region, including Sitka spruce in coastal areas of the Queen Charlotte Islands. Pheromone-baited traps were employed in an ongoing study to determine the taxonomic distribution of **spruce budworms**. A **parasitic microfungus**, Sarea difformis caused branch cankers and stem galls on Sitka spruce near the Tlell River, the first record of this disease on the Queen Charlotte Islands.

Yellow cypress rust was collected for the first time on yellow cedar on the Queen Charlotte Islands.

The **lodgepole pine borer** was collected for the first time on the Queen Charlotte Islands where the **spruce cone maggot** caused severe damage to Sitka spruce seeds.

Pinewood nematode was not identified in any of 41 wood samples collected in the region. A total of 23 male **gypsy moths** were trapped in the Vancouver Region in 1987, four on the lower mainland and 19 on Vancouver Island. Eradication spray and/or saturation trapping programs are planned for the Colwood and Parksville areas in 1988. **Western tent caterpillar** defoliation decreased in the Vancouver Mainland district and remained at 1986 levels on Vancouver Island.

DOUGLAS-FIR PESTS

Western spruce budworm
Choristoneura occidentalis

The western spruce budworm caused light to moderate defoliation over 2850 ha of mature and immature Douglas-fir in the Vancouver Region in 1987 (Map 2), up from 1225 ha in 1986.

Defoliation continued in the Blackwater and D'Arcy Creek drainages and expanded east into the Haylmore Creek drainage and south along the Gates River. The budworm caused light defoliation over 2025 ha in 11 infestations and moderate defoliation over 825 ha in two infestations (Table 1).

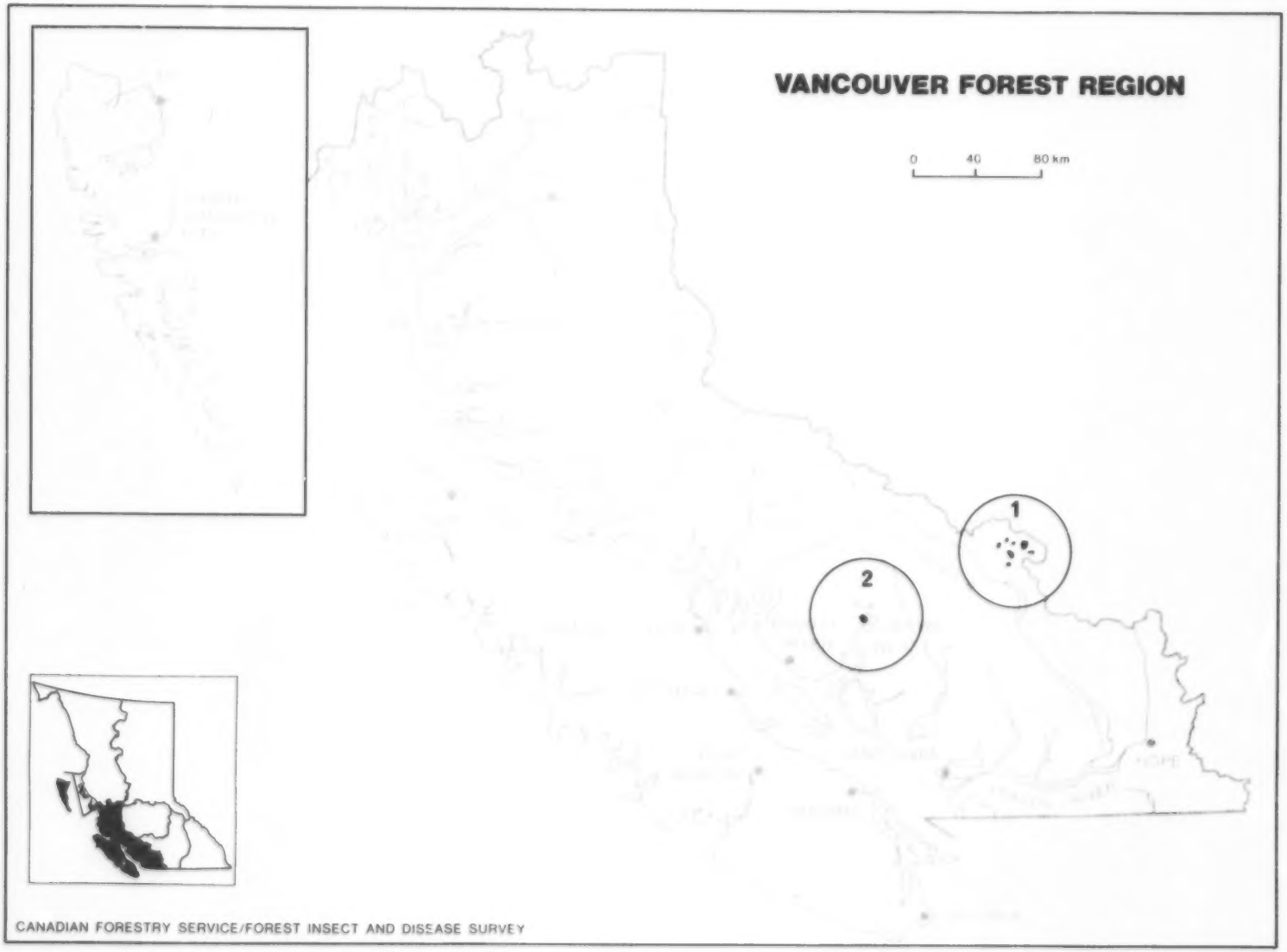
Table 1. Location, area and intensity of Douglas-fir defoliation by western spruce budworm, as determined from aerial surveys, Vancouver Forest Region, 1987.

TSA and Location	Area of defoliation (ha)			
	Light	Moderate	Severe	Total
SOO TSA				
N. Blackwater Creek	560	760		1320
S. Blackwater Creek	1020	65		1085
Haylmore Creek	290			290
Gates River	155			155
Total	2025	825		2850

Defoliation was not recorded on Vancouver Island in 1987 and larval populations remained at trace levels (Table 2). Larval numbers increased in the mainland district; 28% of the beating collections contained larvae averaging 13 larvae/positive sample in 1987, compared to 18% with an average of 4 larvae/positive sample in 1986. Larval parasitism by dipteran and hymenopteran parasites averaged 9.2% at Blackwater Creek, compared to an average of 17.9% province wide.

Table 2. Average number of western spruce budworm larvae/positive beating sample and percent positive collections from Douglas-fir in the Vancouver Forest Region for 1985, 1986 and 1987.

Year	Avg. no. larvae/positive sample		Percent positive collections	
	Van. Island	Van. Mainland	Van. Island	Van. Mainland
1985	4	2	5	8
1986	1	4	5	18
1987	1	13	2	28
Average	2	6.3	4	18



Map 2. Areas where current defoliation by (1) western spruce budworm and (2) western hemlock looper were detected during ground and aerial surveys, 1987

Results of egg mass collections made during September at five locations along the perimeter of the infestation areas were summarized and averaged 84 egg masses per 10 m^2 of foliage, range 18-156 (Table 3). The number of egg masses increased at all locations sampled in 1986 by an average 24%, range 20-32%. An expanding population is expected with light to severe defoliation over a larger area in 1988.

Table 3. Location, average number of western spruce budworm egg masses collected and predicted defoliation for 1988, Vancouver Forest Region, 1987.

Location	Avg. no. of egg masses/10 m^2 of foliage/plot 1986	1987	Percent increase	*Defoliation 1987 (actual)	1988 (Predicted)
S. Blackwater Creek	128	156	22	Light-Moderate	Severe
N. Blackwater Creek	106	140	32	Light-Moderate	Moderate
Devine	15	18	20	Light	Light
S. Haylmore Creek	46	55	20	Light	Moderate
N. Haylmore Creek	(not sampled)	49		Light	Light
Average	74	84	24		

*1-50 egg masses/10m^2 = **Light defoliation:** discolored foliage barely visible from the air, some branch tip and upper crown defoliation.

51-150 " = **Moderate defoliation:** pronounced discoloration, noticeably thin foliage, top third of many trees severely defoliated, some completely stripped.

151+ " = **Severe defoliation:** bare branch tips and completely defoliated tops, most trees more than 50% defoliation.

This year was the first year of an ongoing project to calibrate budworm pheromone traps. If successful, more accurate and early predictions of increasing populations will be made possible. Trap catches are to be compared to larval densities in several areas (Table 4). Multipher traps (5/site) were placed in each of four areas of previous infestation in the Vancouver Region: Devine, Skagit Valley, North Bend and Anderson River. Larval densities were estimated by beating 3 lower branches on each of 25 trees. Larvae beaten from each branch were collected using a 60 x 90 cm tray. Each tree was marked so that the same tree can be sampled next year. The traps were set up at the beginning of July and retrieved after the flight period near the beginning of August. The number of moths was counted and any defoliation that appeared was recorded. Several years of sampling and trapping will be required before any conclusions can be reached. Monitoring of the pest will continue in 1988.

Table 4. Location, number larvae/tree, number of adult male moths/trap and degree of defoliation at four spruce budworm pheromone calibration plots in the Vancouver Forest District, 1987.

Location	Number of larvae/tree		Number of moths/trap		Tree defoliation at plots
	Average	Range	Average	Range	
Devine	4.8	1-12	780	500-1125	Trace
North Bend	0	0	19.3	12-23	None
Anderson Creek	.2	0-1	21.2	19-24	None
Skagit Valley	0	0	0	0	None

Douglas-fir beetle
Dendroctonus pseudotsugae

The area of Douglas-fir beetle attacks decreased for the third consecutive year in the Vancouver Region. In 1987, 42 ha of beetle-attacked trees were mapped compared with 55 ha, 156 ha and 235 ha in 1986, 1985 and 1984, respectively.

Beetle-attacked trees were recorded in eight new infestations at Lillooet Lake and Chilliwack River and one old infestation at Kookipi Creek. Historically, the Douglas-fir beetle has been a much more damaging pest in the interior of the province.

Cone and seed pests

Cone and seed pests infested an average 40%, range 0-100%, of the 100 Douglas-fir cones collected from each of five Vancouver Island seed orchards in 1987 (Table 5). Moderate cone crops were recorded on Vancouver Island this year.

The percentage of cones infested by C. oregonensis, B. colfaxiana, D. abietivorella and C. washingtonensis increased from 1986 levels of 21%, 4%, 4% and 1% to 29%, 13%, 14%, and 2%, respectively. The percentage of cones infested by M. spermotrophus decreased from 20% in 1986 to 7% in 1987. Monitoring of seed orchards will continue in 1988.

Table 5. Incidence of Douglas-fir cone and seed pests, Vancouver Island, Vancouver Forest Region, 1987.

Seed Orchard	% cones infested by pest					Total
	Contarinia oregonensis[1]	Barbara colfaxiana[1]	Megastigmus spermotrophus[1]	Dioryctria abietivorella[2]	Contarinia washingtonensis[3]	
Mt. Newton	25	0	0	0	0	25
Quinsam	30	20	20	15	10	80
Snowdon	90	45	15	55	0	100
Dewdney	0	0	0	0	0	0
Koksilah	0	0	0	0	0	0
Average	29	13	7	14	2	40

[1]major and destroying pest
[2]can be major pest
[3]not a major pest

PINE PESTS

Mountain pine beetle
Dendroctonus ponderosae

Mountain pine beetle infestations covered 1470 ha in 101 infestations, killing 55 500 trees in 1987, a substantial decrease from 126 850 lodgepole pine killed over 4160 ha in 176 infestations in 1986 (Table 6). Volume loss was 38 800 m^3, an almost threefold reduction from 101 480 m^3 lost in 1986. Figures used in this section of the report were obtained from aerial surveys (Map 3) and prism plot cruising (Table 7).

Table 6. Location, area, number and volume of pine trees recently killed by mountain pine beetle as determined from aerial and ground surveys, Vancouver Forest Region, 1987.

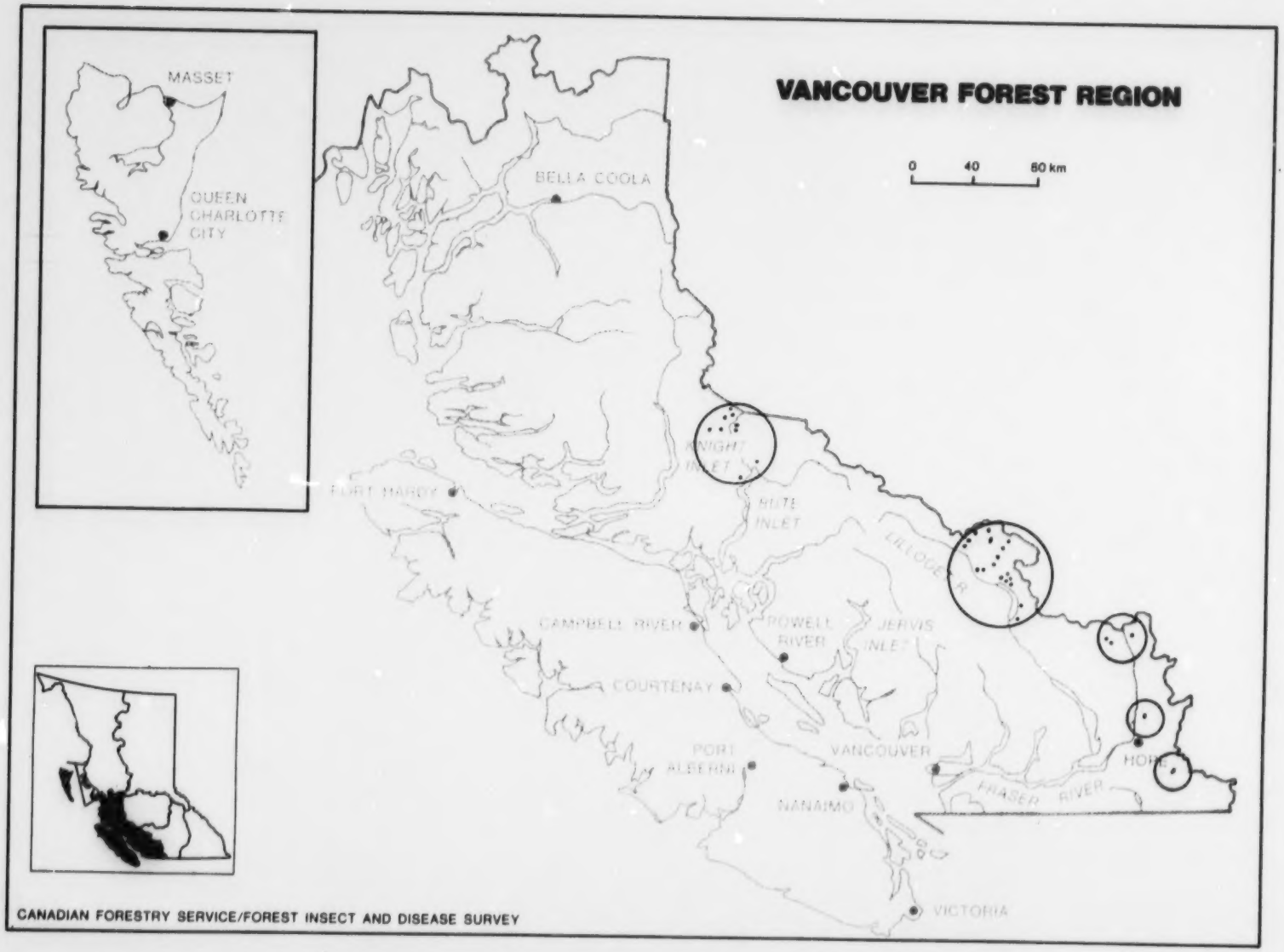
TSA	Area (ha) 1987	No. of trees killed 1987	Volume of host killed (m3) 1987	No. of infestations 1987
Fraser	85	2 100	1 500	7
Soo	565	25 200	17 600	60
Sunshine Coast	820	28 200	19 700	34
Total	1 470	55 500	38 800	101

In the Fraser TSA the volume of recently killed lodgepole pine decreased by 61% to 1500 m^3 and the area of infestation by 55% to 85 ha in 1987. The infestations were recorded along the Fraser River between Hope and Lytton. Logging of infested stands and sanitation cutting by the British Columbia Forest Service are partially responsible for the decline.

A decline in area and volume of trees was also recorded in the Pemberton-D'Arcy area of the Soo TSA and the Homathko River drainage in the Sunshine Coast TSA. The area of beetle attack decreased by 53% to 565 ha in the Soo TSA and by 70% to 820 ha in the Sunshine Coast TSA; the volume of trees killed was down by 63% to 176 000 m^3 and 60% to 19 700 m^3, respectively. The major cause of the decline was lack of suitable host material.

Mountain pine beetle-attacked trees were also reported in Tweedsmuir Park along the Atnarko and Bella Coola rivers. Healthy teneral adults were examined in mid-June in several 15- to 20-cm dbh trees near Big Rock campsite and Burnt Bridge Creek. Pine stands in the area are scattered and of limited size, reducing the chance that beetle populations will build and migrate to larger diameter trees along upper Young Creek.

Current attack trees ranged from 4% of the trees at the west end of Birkenhead Lake to 18% along the south side of Sockeye Creek, averaging 12% down from 19% in 1986 (Table 7). With an average 43% healthy trees in these stands there is sufficient suitable host material to keep the beetle active in small pockets for several years.



Map 3. Areas of lodgepole pine recently killed by mountain pine beetle determined by aerial and ground surveys, 1987

Table 7. Status of lodgepole pine in stands infested by mountain pine beetle, Vancouver Forest Region, 1987.

Location	Percentage of trees attacked				
	1987 (current)	1987 (pitchout/partial)	1986 (red)	Prior to 1986 (grey)	% Healthy
Tenas Creek	13	17	19	22	29
Birkenhead Lake	4	8	12	12	64
S. Sockeye Creek	18	2	24	18	38
N. Sockeye Creek	11	10	22	17	40
Average	12	9	19	17	43

Brood sampling at the four cruise locations indicated decreasing populations at Tenas Creek and Birkenhead Lake, with the population remaining static along the north and south sides of Sockeye Creek (Table 8). The average "R" value (population predictor) increased from 2.16 (a decreasing population) in 1986, to 2.74 (a static population) in 1987.

Table 8. "R" values and 1988 population predictions, Vancouver Forest Region, 1987.

Location	"R" values*	Population prediction
Tenas Creek	2.16	decreasing
Birkenhead Lake	2.30	decreasing
S. Sockeye Creek	3.00	static
N. Sockeye Creek	3.50	static
Average	2.74	

*2.5 and less = decreasing
2.6 to 4.0 = population static
4.1 + = population increase

Populations are expected to remain active in the Birkenhead area over the next several years but are expected to be restricted to small scattered mature pine sites.

Pine needle sheathminer
Zelleria haimbachi

The pine needle sheathminer was active in the Vancouver Region for the second consecutive year, defoliating immature lodgepole pine over 155 ha at six locations (Table 9). The percentage of trees attacked ranged from 60% at Keefers to 100% at Cartmell Creek and Woods Lake, average 77%. Defoliation of the current year's growth ranged from 5% at Keefers to 45% at Woods Lake, average 21%.

Table 9. Location, area, percent trees attacked and defoliation of lodgepole pine by pine needle sheathminer in the Vancouver Region, 1987.

Location	Area (ha)	% trees attacked	% defoliation
Twin One Creek	20	73	25
Cartmell Creek	55	100	20
Woods Lake	20	100	45
Devine	15	60	20
Keefers	15	60	5
Nahatlatch River	30	70	10
Total	155		
Average		77	21

Populations are expected to decline in 1988 as historically infestations have lasted only two years. Young pine stands will continue to be monitored in 1988.

Pine engraver beetle
Ips pini

The pine engraver beetle attacked 18% of the mountain pine beetle-infested lodgepole pine near Birkenhead Lake, a decrease from 50% in 1986. The pine engraver beetle also killed approximately 30 western gall rust-infected lodgepole pine trees along Bonnevier Ridge in Manning Park.

Ips pini populations usually develop in windfalls and slash. Outbreaks are of short duration, seldom lasting more than one or two years.

HEMLOCK PESTS

Western hemlock looper
Lambdina fiscellaria lugubrosa

Western hemlock looper lightly to severely defoliated over 90 ha of western hemlock, western red cedar, broadleaf maple and shrubs north of Sechelt on the west side of Jervis Inlet (Map 2). This is the first record of an infestation north of Howe Sound in the Vancouver Mainland district. The most serious damage occurred on western hemlock between Patrick Point and Crabapple Creek on the southwest side of Queens Reach with up to 90% defoliation on individual trees, average 50%, of old and new needles.

The site was first visited in mid-September after discoloured trees had been noted from the air by industry and British Columbia Forest Service personnel in early August. Though adults were numerous during the September survey, egg sampling was not completed due to lack of suitable host material (lichen) in the area.

Populations of hemlock looper have been low since 1973 when the looper defoliated 285 ha of western hemlock and amabilis fir at Coquitlam Lake. Significant timber losses were recorded on Vancouver Island between 1945 and 1947 due to the hemlock looper but the mortality was restricted to old growth hemlock stands. Outbreaks usually last about three years and generally collapse due to natural agents. Monitoring of the hemlock looper will continue in 1988 with increased surveys at previous infestation sites.

Western blackheaded budworm
Acleris gloverana

The blackheaded budworm lightly defoliated mature western hemlock over 5 ha at William Lake near Holberg on Vancouver Island in 1987. Defoliation was first noted in September by forest industry personnel engaged in low altitude helicopter surveys.

FIDS and Western Forest Products personnel visited the site at the end of September to assess damage and to conduct an egg survey. Egg counts were high with 76 eggs/branch at William Lake, indicating that severe defoliation can be expected in 1988.

The last recorded infestation on Vancouver Island defoliated 164 000 ha of western hemlock and amabilis fir from Jordan River to Holberg between 1970 and 1973. Populations have remained at low endemic levels since.

To monitor the threat of expansion of the infestation at William Lake, increased surveys of surrounding areas and previous infestation sites will take place in 1988.

TRUE FIR PESTS

Western balsam bark beetle-fungus complex
Dryocoetes confusus
Ceratocystis dryocoetidis

This insect-disease complex killed 10 450 high-elevation alpine fir over 420 ha in 1987 down from 14 700 trees over 420 ha in 1986 (Table 10). Tree mortality was recorded throughout the Vancouver Region with 315 ha, 65 ha and 40 ha recorded in the Fraser, Soo and Sunshine Coast TSAs, respectively.

Table 10. Location, area, number and volume of balsam trees recently killed by western balsam bark beetle-fungus complex determined from aerial surveys, Vancouver Forest Region, 1987.

TSA and Location	Area (ha)	No. of trees killed	Volume of host killed (m^3)
Fraser TSA			
Anderson River	15	400	430
Kookipi Cr.	100	2 500	2 675
Mowhokam Cr.	145	3 600	3 960
Sowaqua Cr.	55	1 350	1 485
Soo TSA			
Haylmore Cr.	10	250	275
Cayoosh Cr.	55	1 350	1 485
Sunshine Coast TSA			
Alfred Cr.	40	1 000	1 100
Total	420	10 450	11 410

Western balsam bark beetle occurs throughout British Columbia, mainly on alpine fir, although amabilis fir may be attacked. This insect, in association with the lesion-causing fungus, Ceratocystis dryocoetidis, attacks and kills the cambial tissues of Abies spp. Control at present is not feasible, although salvage logging will reduce actual timber loss.

Balsam woolly adelgid
Adelges piceae

Surveys to delineate the current distribution of woolly adelgid were carried out in the Vancouver Region during 1987. Intensified surveys were initiated after balsam woolly adelgid was found on West Thurlow Island well north of the current regulation (quarantine) boundary. Collections were made at 25 locations on Vancouver Mainland and 39 locations on Vancouver Island. At each location up to 100 true fir were checked for stem attack and branches examined for the presence of adelgids and gouting. All the positive samples

(21%), except for West Thurlow Island, were in the balsam woolly adelgid regulation zone (Map 4).

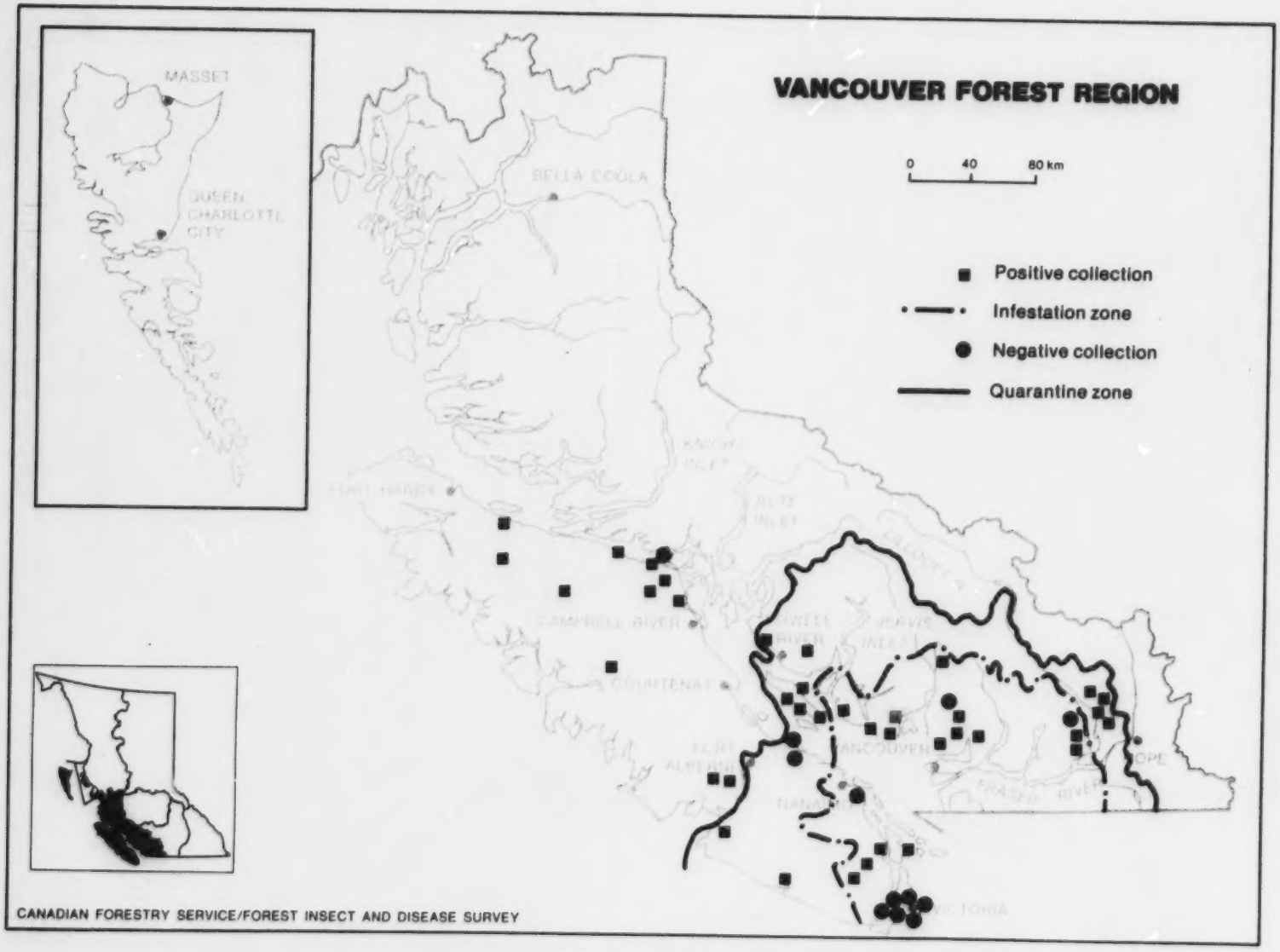
Positive samples were collected from amabilis fir at Chehalis River, Mamquam River, Waterloo Mountain, Pacific Forestry Centre, West Thurlow Island, CIP, Dewdney, Mt. Newton and Yellow Point Seed Orchards; from grand fir at Thetis Lake, Rathtrevor Park, and Parksville. Negative collections from amabilis fir were made at Adams River, Jeune Landing, Rock Bay, Elk Falls, Capilano River, Seymour River, Coquitlam River, Hornet Creek, Cheakamus Lake, Mt. Porteous, Chehalis Creek, Hat Creek, Langdale, Woss, Nimpkish, Port McNeill, Memekay River, Drum Lake, Gracie Lake and Stella Lake; from grand fir at Qualicum Beach, French Beach, Buckley Bay, Cape Lazo, Comox, Sechelt, Halfmoon Bay, Gillies Bay, Harwood Point, Myrtle Point, Scuttle Bay, Tunstall Bay, Menzies Bay, Sayward, Eve River, Sproat Lake, Maple Bay, Ruckles Beach, Little Nitinat River, Port Renfrew and Duncan; from alpine fir at Whistler. Sampling for the balsam woolly adelgid will continue in 1988.

Resurvey of balsam woolly adelgid plots

Ten balsam woolly adelgid plots established by the CFS throughout the region between 1966 and 1970 were resurveyed in 1987. The original plots were assessed when the old plot boundaries could be located and trees identified, otherwise a random 100-tree tally was taken in the general plot location. Natural regeneration was also assessed at each plot to determine the balsam component and its condition (Table 11). Balsam mortality within the stands varied from 0-95%, average 14%. The natural balsam component of regeneration in the stands averaged 16.5%, range 0-40%, with no relationship established between percent balsam component in the regeneration and percent mortality of the mature trees. No balsam woolly adelgids were collected from the balsam regeneration in any of the surveyed stands.

Table 11. Location, percent mortality, trees attacked by bark beetle and balsam component of natural regeneration in balsam woolly adelgid mortality plots, Vancouver Forest Region, 1987.

Location/Plot #	No. trees examined	Percent of: Mortality	Trees infested by *Pseudohylesinus grandis*	Balsam component in regeneration
Lynn Valley #2	100	18	0	5
Seymour River #8	100	1	18	40
Seymour River #9	100	3	27	5
Seymour River #203	100	16	36	0
Seymour River #204	100	3	0	30
Seymour River #225	100	1	2	40
Mt. Seymour Park #206	100	4	0	40
Langdale #13	7	95	0	0
Port Mellon #3	100	4	0	0
Thetis Lake #1	60	0	0	0
Average		14.5	8.3	16.5



May 4. Locations of true fir stands surveyed to detect balsam woolly adelgid, 1987

Severe true fir mortality, 95%, occurred in the Langdale stand where only 7 of the original 60 plot trees were still standing and of these only 3 were alive. The reason for the high mortality is not known. This is in marked contrast to the Port Mellon plot 3 km to the northeast where only 4% mortality was recorded and the remaining balsam is thriving. Thetis Lake was the only plot where active stem-feeding (did not sample crowns) adelgid populations were collected. Populations may still be present at all sites but at low levels and/or restricted to the upper crowns; sampling for the adelgid will continue in 1988.

A true fir bark beetle
Pseudohylesinus grandis

A true fir bark beetle infested an average 25%, range 2-36%, of the semimature and mature balsam at four Seymour River locations and one site along the Capilano River. Attacks were noted along the entire bole of infested trees but no mortality was noted. This bark beetle is usually associated with *P. granulatus* although none was collected at the five sites surveyed this year. Recurrent attacks may eventually kill the trees.

Fir engraver
Scolytus ventralis

The fir engraver beetle killed 12 grand fir north of Sechelt and 5 grand fir at Harwood Point on Texada Island in 1987. The attacked trees were under stress from drought and infected by the non-aggressive fungi *Ascocoryne sarcoides* and *Claussenomyces olivaceus*. Exit holes and new adults were numerous in killed trees and evident in surrounding living trees. Broods may develop and emerge without destroying sufficient cambium to kill the tree. A stain fungus, *Trichosporium symbioticum*, causing a yellow-brown discoloration of the area around a gallery, is thought to dry out the cambium and aid in brood development. Previous outbreaks have been mainly confined to southern Vancouver Island on grand fir.

A balsam twig miner
Argyresthia sp.

An unidentified species of twig miner has been found on grand fir near Qualicum Beach and Victoria. This insect and its damage has not previously been recorded in Western Canada.

The larva mines the leader and branch tips of grand fir. Damage usually occurs on the current year's growth but also occurs on 2-year-old twigs. Attacked shoots and leaders are severely stunted and chlorotic. Dieback to the node below attack is likely in spring.

Surveys to determine distribution and damage will continue in 1988.

SPRUCE PESTS

Spruce beetle
Dendroctonus rufipennis

No new spruce beetle infestations were visible during aerial surveys in July of 1987 after two years of increase in the Vancouver Mainland district. In 1986, 327 ha of beetle-killed spruce were mapped in the Smokehouse Creek drainage 50 km south of Rivers Inlet. Spruce beetle populations are kept under control by natural control factors, some of which are predation by insects and birds, parasites and nematodes. Surveys to monitor this pest will continue in 1988.

Spruce weevil
Pissodes strobi

Spruce weevil attacked an average of 4%, range 0-6%, of Sitka spruce leaders at six plantation sites on Vancouver Island in 1987. Damage caused by attack prior to 1987 averaged 30.5%, range 2-78% (Table 12).

The incidence of current attack is similar to 1985 levels of 5%. More than one year's attack was visible on scattered trees near Grice Bay Rd. and at Km 10 of Kennedy Lake Road.

There is a potential for a reduction of merchantable timber at rotation age due to crooks, stem decay and other deformities resulting from weevil attack. Surveys of spruce stands will continue in 1988.

Table 12. Location and percent of spruce weevil attack in Sitka spruce stands, Vancouver Island, Vancouver Forest Region, 1987.

Location	Percent of trees attacked		
	1987	Previous	Total
Fairy Lake	2	8	10
Holiday Cr.	5	10	15
Eve River	0	2	2
Grice Bay Rd.	6	60	66
Kennedy Lake Rd. 10 km.	6	78	84
Spirit Lake	5	25	30
Average	4	30.5	34.5

Spruce aphid
Elatobium abietinum

Spruce aphid populations increased throughout the Vancouver Region in 1987, defoliating native and ornamental spruce at scattered sites from Port Hardy to Hope. Damage was most severe on ornamentals with up to 100% loss of

old needles. In shelter belts of less than 50 trees in the Maple Ridge area native Sitka spruce lost an average 25% (range 10-80%) of old foliage. Mild weather during the winter of 1987-88 may result in continued damage and possible mortality in 1988.

CEDAR PESTS

A gall midge
Contarinia new species

A new species of gall midge attacking yellow cedar (Chamaecyparis nootkatensis) was found at three seed orchards and two residential sites on southern Vancouver Island by FIDS staff. Subsequent surveys confirm distribution throughout much of the host range with positive samples from Sooke, Port Hardy, Harrison Mills, Hope and Prince Rupert.

Feeding by the gall midge larva causes twisting of new shoots and galling of terminal growth on branches. Galled twigs die back to the nearest crotch. Damage occurs primarily on vegetative growth (98%) with only a minor amount of the total damage occurring on reproductive structures (2%). About 4% of the male cones and 2% of the new female cones were destroyed by the gall midge at Saanichton Seed Orchard. At Saanichton 1.4% of all shoot tips were damaged while in natural stands less than 0.1% of all buds were infested.

While damage seems minimal at this time, monitoring will continue in 1988.

Western cedar borer
Trachykele blondeli

This beetle is widespread in the semimature western red cedar on Texada Island and along the mainland coast between Gibsons Landing and Lund. Damage is common in cedar trees growing on sites with sunny aspects below 250 m elevation. Exposed locations such as shorelines, selectively logged areas or borders of clearcuts seem to be the preferred locations of infestations. The borer usually attacks living western red cedar without visible injury. Infested trees are readily determined once they have been felled and bucked as the larval tunnels are exposed in the knot face or cross-section. Damage caused by this insect often results in the culling of logs and lumber. Direct control of the borer is difficult, since the larvae are mostly found in the heartwood.

MULTIPLE HOSTS PESTS

Young stand surveys

A total of 17 natural and planted stands were surveyed for pest problems in 1987 (Table 13). Major pests included pine needle sheathminer on lodgepole and ponderosa pine; blister rust on western white pine; Cooley spruce gall adelgid on Douglas-fir and spruce, and deer browse on several species.

Monitoring of pest problems in young stands will continue in 1988.

Table 13. Pests of young stands, Vancouver Forest Region, 1987

Location	Host	Age	Stand Type	No. trees examined	% trees affected	Pest present	Intensity
Dewdney Cr.	D-fir	12	natural	82	54	Adelges cooleyi	light
					10	deer browse	moderate
	wwP			2	50	Cronartium ribicola	severe
Keefers	lP	10	natural	58	45	Zelleria haimbachi	moderate
	pP			21	10	" "	light
Mouat Cr.	D-fir	10	natural	67	82	Adelges cooleyi	light
					9	deer browse	moderate
	lP			11	9	Scythropus californicum	moderate
	wwP			16	13	" "	moderate
					19	Cronartium ribicola	moderate
Harris Lake	wrC	10	natural	71	30	drought stress	moderate
	wwP			3	66	Cronartium ribicola	severe
Lillooet R. Rd.	D-fir	15	natural	15	86	Adelges cooleyi	light
					2	Choristoneura occidentalis	light
					2	sunscald	moderate
Chipmunk Cr.	D-fir	12	natural	51	82	Rhabdocline pseudotsugae	severe
					29	Adelges cooleyi	light
					2	Neodiprion sp.	light
Twin One Cr.	lP	2-10	natural	51	73	Zelleria haimbachi	moderate
					2	Endocronartium harknessii	severe
	D-fir			37	19	Adelges cooleyi	light
40 km Silver-Skagit Rd.	wwP	5	natural	80	35	Cronartium ribicola	severe
					13	rodent damage	severe
Memekay R.	D-fir	7	natural	31	25	Adelges cooleyi	light
	wH			37		negative	
Grice Bay Rd.	D-fir	10	planted	7	100	Adelges cooleyi	light
	sS			17	88	" "	light
					66	Pissodes strobi	light
	wrC			20		negative	
	wH			4		negative	

Location	Host	Age	Stand Type	No. trees examined	% trees affected	Pest present	Intensity
Eve River	D-fir	5	planted	51	90	Adelges cooleyi	light
					37	deer browse	light
					24	multiple leaders	moderate
	wH			44	2	sunscald	light
	wrC			1		negative	
	sS			12	33	Adelges cooleyi	light
Carnation Cr.	wH	7	natural	35		negative	
	sS			6	33	Adelges cooleyi	light
Muchalat Main	D-fir	3	natural	26	42	deer browse	light
1 km					14	Adelges cooleyi	light
	wH			5		negative	
Kennedy R. Rd.	D-fir	10	planted	2	100	Adelges cooleyi	light
6 km	lP			47		negative	
	wH			1		negative	
	wwP			1		negative	
Fairy Lake	gF	12	planted	12	8	deer browse	light
	sS			18	10	Pissodes strobi	light
					16	Adelges cooleyi	light
Holiday Cr.	D-fir	15	natural	9	100	Adelges cooleyi	light
	sS			33	85	" "	light
					15	Pissodes strobi	light
	wH			12		negative	
	wrC			1		negative	
	wwP			1		negative	

D-fir - Douglas-fir sS - Sitka spruce gF - grand fir wH - western hemlock
wrC - western red cedar pP - ponderosa pine wwP - western white pine lP - lodgepole pine

Gypsy moth
Lymantria dispar

About 8244 pheromone-baited sticky traps were monitored throughout British Columbia in the thirteenth year of the cooperative program with Agriculture Canada (Plant Health), the British Columbia Forest Service and the Forest Insect and Disease Survey of the Canadian Forestry Service. A total of 23 gypsy moths were trapped in the Vancouver Region in 1987, 4 in 3 traps on the lower mainland and 19 moths in 12 traps on Vancouver Island (Table 14). In addition, 3 new and 29 old egg masses were collected at Parksville, and 7 new at Colwood.

During 1986, 8 males, 7 females and 7 egg masses were collected at the military base in Chilliwack. Aerial and ground sprays of *Bacillus thuringiensis* applied in May and June of 1987 by Agriculture Canada over 25 ha on and around the base effectively controlled the threat of an infestation.

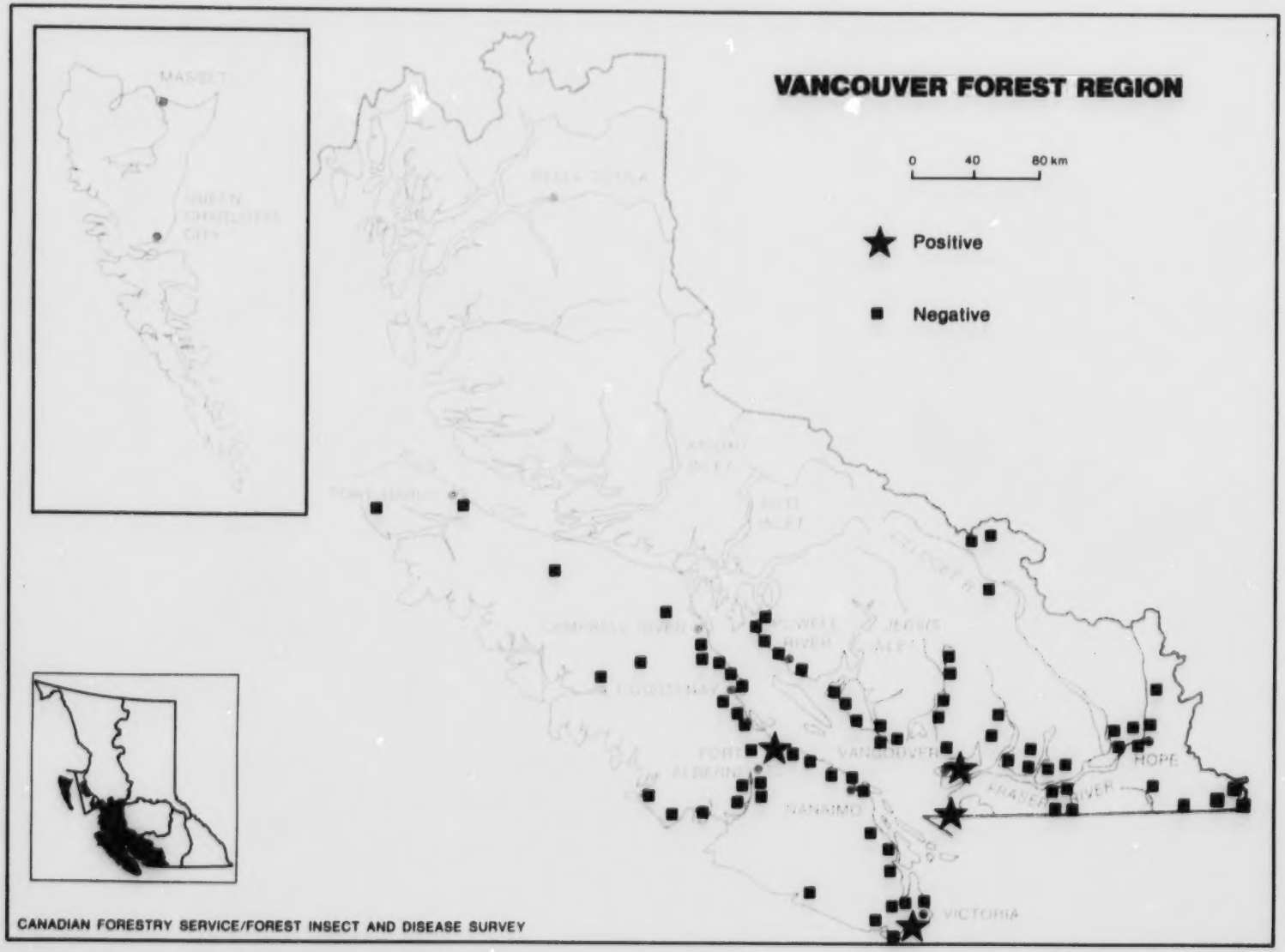
Table 14. Locations where adult male gypsy moths were trapped in sticky traps baited with sex pheromones in the Vancouver Region, 1987.

Location	No. of adults trapped	No. of traps
Central Vancouver	1	1
Tsawwassen	3	2
Colwood	6	5
Parksville	12	6
Qualicum Beach	1	1
Total	23	15

The moths and egg masses recovered at Parksville were probably introduced on a trailer that was brought from Michigan, U.S.A., as old egg masses were found on the trailer and the new egg masses were within 50 m. The gypsy moth was introduced into the United States in 1869; infested areas now include most of the northeastern states and adjacent provinces.

The Canadian Forestry Service placed a total of 94 gypsy moth pheromone traps in the Vancouver Region, especially in parks and military bases, all of which were negative (Map 5). Eradication spray programs are planned for the Colwood and Parksville areas in 1988.

Pheromone trapping programs are expected to continue in 1988.



Map 5. Location of pheromone-baited traps to monitor gypsy moth placed by CFS-FIDS, and where adult males were caught, 1987

Pinewood nematode
Bursaphelenchus xylophilus

No pinewood nematode was found in 40 wood samples collected from eight different conifer species or from three woodborer adults (Map 6). Woodborer (*Buprestis rusticorum*) adults were collected from turpentine-baited flight traps placed in various locations throughout the mainland district. The beetle is considered to be a possible vector of the nematodes, but none was found.

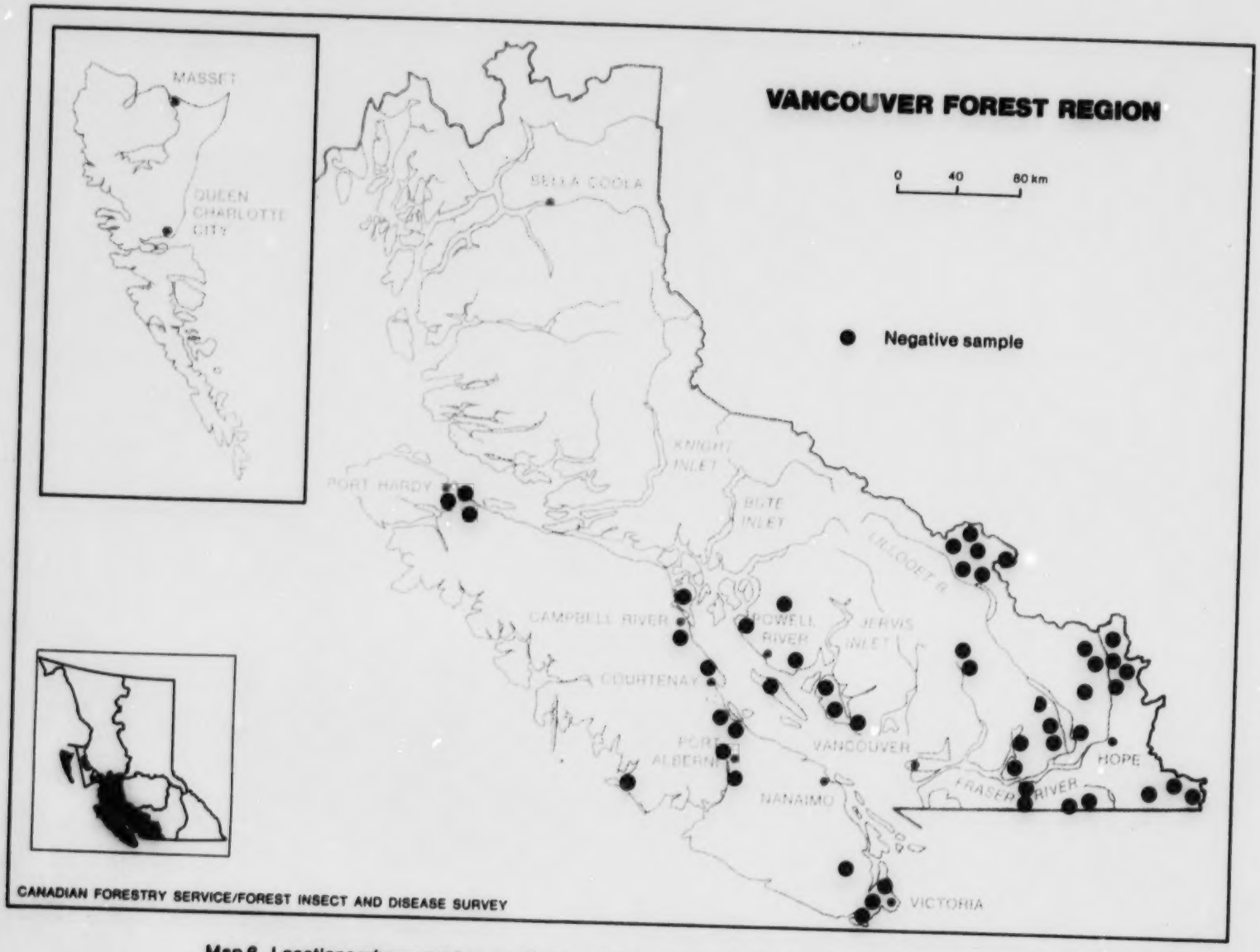
The possibility of export restrictions of all coniferous raw materials exists if populations of this pest are found. This requires ongoing pine sampling throughout B.C. in order to determine the distribution and severity of the disease and its vectors, and obtain phytosanitary certificates. The pinewood nematode was responsible for mortality of pines over large areas in Japan over the past three decades.

Fir coneworm
Dioryctria abietivorella

The coneworm was widespread in the Vancouver Mainland district in 1987, devastating Douglas-fir cone crops in many areas. In Douglas-fir stands at Boston Bar, up to 90% of the cones were infested. Cone crops were generally light this year; this in conjunction with the fir coneworm resulted in much reduced seed yields. Damage to the cambial layer of leaders on amabilis and Douglas-fir caused by coneworm feeding was also recorded in scattered areas throughout the region.

Root collar weevil
Steremnius carinatus

The root collar weevil caused very low mortality of recently planted western hemlock seedlings on northern Vancouver Island in 1987. Surveys by Western Forest Products personnel near Holberg showed low levels of mortality, <1%, up slightly from 1986, 0.6%. The adults girdle 1- and 2-year-old seedlings at the ground line; Douglas-fir, balsam, spruce and western red cedar are also attacked. Mortality in new plantations on the island is expected to continue in 1988.



Map 6. Locations where wood or woodborer collections were made for pinewood nematode, 1987

DECIDUOUS TREE PESTS

Western tent caterpillar
Malacosoma californicum pluviale

Western tent caterpillar defoliation decreased on Vancouver Mainland in 1987 after five consecutive years of expansion. Population and defoliation levels remained the same as 1986 on Vancouver Island and the Gulf Islands.

Light to severe defoliation of deciduous trees and shrubs occurred along the east coast of Vancouver Island from Victoria to Campbell River and on the Gulf Islands. The most severe defoliation was recorded from Victoria to Nanaimo and the Gulf Islands, especially Galiano Island.

The tent caterpillar was responsible for light defoliation of red alder and various deciduous trees and shrubs in widely scattered locations throughout the mainland district. Larvae examined during the spring of 1987 at several locations showed evidence of virus and/or disease in the population. Dry shriveled immature larvae were observed on the tent webbing and mature larvae were hanging from leaves and branches indicating a diseased population.

Egg mass sampling results indicate a declining population and collapse of infestations at all locations in 1988 (Table 15). In 1987 the number of egg masses declined to 0 from 6 in 1986 at the Victoria sample site. At Herd and Osborne roads in Duncan and at Crofton, the ratios of new to old are 1:2, 0:6 and 0:3, respectively. Populations are expected to decline to endemic levels in 1988.

Table 15. Location, number of new and old egg masses and defoliation forecast for 1988, Vancouver Island, 1987.

Location	No. new egg* masses per tree	No. old egg masses per tree	Defoliation prediction
Victoria	0	6	decrease
Herd Rd.	1	2	decrease
Osborne Rd.	0	6	decrease
Crofton Ferry	0	3	decrease
Total	1	17	
Average	.25	4.25	

*Based on 10 branches per site on 10 trees per site, sampled in late August and September, 1987.

Dogwood leaf blight
Gloeosporium sp.

Western flowering dogwood trees are continuing to die in the Vancouver Region (average 2% mortality) from the accumulated effects of annual infection by the leaf blight. Infection was widespread again this year causing an average 24% defoliation of affected trees from Yale to Powell River on the mainland and from Victoria to Port Alberni on Vancouver Island (Table 16).

Defoliation ranged from none at Nairn Park south of Pemberton to 55% along the Sunshine Coast. Mortality was recorded at Harrison Lake and Powell River with 5% and 10%, respectively. Dead trees were heavily overgrown and shaded. Moist spring weather will facilitate continued infections in 1988.

Table 16. Location, percent trees affected, defoliation, mortality and branch dieback of western flowering dogwood trees in the Vancouver Region, 1987.

Location	Percent			
	Trees affected	Defoliation	Mortality	Branch dieback
Peace Arch Park	100	50	0	8
Emory Park	100	20	0	2
Alexandria Bridge Park	60	10	0	1
Sunshine Coast	100	55	5	20
Harrison Lake	100	10	10	25
Nairn Park	0	0	0	0
Stamp Falls Park	100	20	0	5
Sproat Lake Park	100	50	0	5
Gulf View Park	100	5	0	5
Average	84	24	2	8

Broadleaf maple dieback

Broadleaf maple dieback or leaf scorch continued on scattered roadside and open growing trees throughout the host range in the Vancouver Region during 1987. Up to 100% of the leaves were affected on trees in the Cultus Lake-Chilliwack River area and from Victoria to Nanoose, 30% of the foliage, range 0-90%, on 20% of the broadleaf maple, was scorched.

The cause of the dieback is still unknown. In a recent publication[1], a fastidious, xylem-inhabiting bacterium (FXIB) was found to be causing similar damage in red maple (*Acer rubrum*) in the eastern United States. Tests using the electron microscope are planned for samples taken from Vancouver Island in 1988, to determine if a similar organism is involved here.

[1]Sherald, J.L., Wells, J.M. and Hartt, S.J. 1987. Association of fastidious, xylem-inhabiting bacteria with leaf scorch in red maple. Plant Disease 71:930-933.

Winter moth
Operophtera brumata

Defoliation by the winter moth continued for the seventeenth consecutive year in the Greater Victoria, Colwood and Saanich Peninsula areas. Damage occurred on broadleaf maple, Garry oak and fruit trees in patches of trace to light defoliation. No visible defoliation was observed at Duncan, Saltspring Island or Nanaimo where winter moth has been previously collected.

Between 1979 and 1981 30,000 larval parasites were released in the Victoria area. *Cyzenis albicans* and *Agrypon flaveolatum* are now established and have contributed to a significant decline in winter moth populations.

Western winter moth
Erannis tiliaria vancouverensis

The western winter moth defoliated up to 50% of the leaves on scattered patches of vine maple in Golden Ears Park, Skagit Valley and the Gilt Creek area southeast of Boston Bar. An average 10% defoliation was recorded in all areas on willow and broadleaf maple. This feeding pattern is unusual as broadleaf maple has previously been recorded as the primary host. The last infestation was recorded in 1972 at Railroad Creek; infestations are usually of short duration.

Birch-aspen leafroller
Epinotia solandriana

This transcontinental pest of broadleaved trees was widespread in scattered locations in the Vancouver Mainland district in 1987. Infestations were recorded in the Skagit Valley, Capilano Watershed and along Harrison Lake. The leafroller attacked alder and willow for 20 km along the Skagit River Road infesting an average 30% of the leaves on 90% of the trees. The same hosts were defoliated to a lesser extent at scattered sites in the watershed and at Harrison lake. Damage is of more esthetic than economic importance.

SPECIAL SURVEYS

Seed orchards

Twelve seed orchards in the Vancouver Region were surveyed a total of 22 times in 1987 for early detection of pests, damage assessments and discussion of management options. During surveys 20 pests were recorded, of which 10 can be considered significant (Table 17).

Table 17. Pests of seed orchards, Vancouver Forest Region, 1987.

Seed Orchard	Host[1]	Pest	Intensity[2]	% trees affected
VANCOUVER ISLAND				
Dewdney	D-fir	Adelges cooleyi	light	8
		Rhabdocline pseudotsugae	moderate	10
	sS	Elatobium abietinum	light	36
	aF	Adelges piceae	light	36
Mt. Newton	D-fir	Adelges cooleyi	light	85
		Contarinia oregonensis	moderate	90
	aF	Adelges piceae	light	8
	wrC	Mayetiola thujae	light	40
C.I.P.	D-fir	Adelges cooleyi	moderate	90
	sS	Adelges cooleyi	light	5
	aF	Adelges piceae	light	5
	yC	Contarinia sp.	light	100
Lost Lake	sS	Adelges cooleyi	light	25
		Pineus similis	light	50
	wrC	Argyresthia sp.	light	20
		Mayetiola thujae	moderate	100
Cobble Hill	sS	Adelges cooleyi	light	25
		Elatobium abietinum	light	30
Koksilah	D-fir	Adelges cooleyi	light	60
		Pityophthorus orarius	light	15
Yellow Point	sS	Adelges cooleyi	light	2
		chlorosis	light	50
	aF	Adelges piceae	light	10
Harmac	D-fir	Adelges cooleyi	light	50
	wH	Adelges tsugae	severe	80

Seed Orchard	Host[1]	Pest	Intensity[2]	% trees affected
Quinsam	D-fir	Adelges cooleyi	light	5
		Contarinia oregonensis	severe	30
		Barbara colfaxiana	moderate	90
		Dioryctria abietivorella	moderate	90
		Megastigmus spermotrophus	moderate	90
		Contarinia washingtonensis	light	90
Snowdon	D-fir	Adelges cooleyi	light	15
		Contarinia oregonensis	severe	90
		Barbara colfaxiana	severe	90
		Dioryctria abietivorella	severe	90
		Megastigmus spermotrophus	moderate	90
VANCOUVER MAINLAND				
Sechelt	wH	twig dieback	light	11
	D-fir	Adelges cooleyi	light	40
		Dioryctria sp.	light	9
		sunscald	light	25
Surrey	wH	Acleris gloverana	light	1
		Dioryctria sp.	light	1
	D-fir	Rhabdocline pseudotsugae	moderate	72
		Adelges cooleyi	moderate	88

[1] aF amabilis fir
D-fir Douglas-fir
sS Sitka spruce
wH western hemlock
yC yellow cedar
wrC western red cedar

[2] light - small populations/light infection/little or no damage 0-10%
moderate - medium populations/infections/some damage or loss 11-30%
severe - large populations/severe infections/serious loss or potential for loss/action indicated >30%

The most serious are the cone and seed pests, Megastigmus spermotrophus, Contarinia washingtonensis, Barbara colfaxiana, Dioryctria abietivorella and Contarinia oregonensis, which moderately to severely infested the Douglas-fir cone crop on 90% of the trees at Mt. Newton, Quinsam and Snowdon seed orchards. Cooley spruce gall adelgid, Adelges cooleyi, discolored needles in 5-90% of the Douglas-fir. Galls were formed on 2-25% of the spruce by the same pest in 80% of the spruce orchard surveys. Balsam woolly adelgid, Adelges piceae, was present in 5-36% of the true firs in Dewdney, CIP, Mt. Newton and Yellow Point seed orchards. Douglas-fir twig beetle, Pityophthorus orarius, caused light damage at Koksilah seed orchard. Surveys will continue in 1988.

Acid rain plots

The 10 ARNEWS (Acid Rain National Early Warning System) study plots in the Vancouver Region were visited at least twice each during 1987. No sign of acid rain damage was recorded, but mimicking symptoms caused by a leaf fungus, Septoria alni, were collected from red alder at one Seymour River plot.

These plots are part of a national system to gather baseline data on acid rain in Canada's forests. The data is needed to clearly and accurately detect early signs of acid rain damage and to annually monitor for changes in forest soil, vegetation and trees which may be related to acidification of precipitation, fog, clouds or other atmospheric pollutants.

Fume damage

Sulphur dioxide

No foliage discoloration was visible in the Port Alice area during aerial surveys in 1987, a significant decrease from 1986 when 240 ha of suspected fume damage on mature western hemlock were mapped near the Port Alice pulp mill. Ground surveys in 1987 revealed that 1% of the foliage on 70% of the red alder and salmonberry had trace interveinal necrosis and chlorosis. No damage was found on western hemlock. FIDS will continue monitoring the fume damage site and surrounding areas.

Minor pests

Collections and records were made of many pests currently at endemic levels (Table 18). These pests include Swiss needle cast, European pine shoot moth, fall webworm, poplar leaf blight and other insects and diseases.

Table 18. Pests currently at endemic levels, Vancouver Forest Region, 1987.

Pest	Host*	Location	Damage	Status
Douglas-fir growth anomalies	D-fir	Vancouver Island Lower Mainland	light except at Eve River near Campbell River where 24% of the D-fir has multiple leaders	static
Douglas-fir tussock moth, Orgyia pseudotsugata	D-fir	Vancouver Region	none	endemic
Pine butterfly, Neophasia menapia	D-fir	Vancouver Region	none, noticeable moth flights common in the region	increasing
Silver spotted tiger moth, Lophocampa argentata	D-fir	Vancouver Island	occasional, scattered colonies, caused trace defoliation	static
Swiss needle cast, Phaeocryptopus gaeumannii	D-fir	Campbell River to Victoria	no damage recorded	endemic
European pine shoot moth, Rhyacionia buoliana	orna-mental pines	Victoria to Nanaimo	light bud mining	static
Western gall rust, Endocronartium harknessii	sP	Hornby Island	1 or more galls per tree on 20% of the semimature shore pine over 5 ha at Helliwell Provincial Park	static
Green-striped forest looper, Melanolophia imitata	wH	Vancouver Region	no damage or larvae collected. In 1986 an average of 1 larva per collection on 5% of the Douglas-fir and 2.3 larvae on 4% of the western hemlock were collected	endemic

Pest	Host*	Location	Damage	Status
Hemlock twig dieback, Sirococcus strobilinus	wH	Haney	dieback to 5% of the new twigs throughout the Haney Research Forest	endemic
Phantom hemlock looper, Nepytia phantasmaria	wH	Vancouver Region	no damage or larvae collected	endemic
Balsam twig aphid, Mindarus abietinus	aF	Texada Island	distortion of 10% of the new needles	static
Cooley spruce gall adelgid, Adelges cooleyi	sS eS D-fir	Vancouver Region	light galling on spruce, needle discoloring on D-fir widespread throughout the region	static
Spruce budmoth, Zeiraphera sp.	sS	Tofino	30% of the new buds were damaged on 1% of the sS near Long Beach	static
Cedar leaf blight, Didymascella thujina	wrC	Vancouver Region	light infections in most of the region; damage is rarely serious	static
Cypress tip moth, Argyresthia sp.	ornamental juniper and cedar	Victoria	light foliage damage with occasional branch mortality	static
Climatic damage	D-fir wH wrC	Vancouver Island	occasional, scattered dead tops and mortality; cause is unknown	declining
Woolly alder sawfly, Eriocampa ovata	rA	Chehalis River	20% of the leaves were skeletonized over 50 ha	static

Pest	Host*	Location	Damage	Status
Arbutus leaf spots, Didymosporium arbuticola, Diplodia maculata, Coccomyces quadratus, Rhytisma arbuti	Arb	Victoria to Parksville	light damage on southern Vancouver Island and the Gulf Islands; 30% of the foliage on 70% of the arbutus at Bamberton Prov. Park and 20% of the foliage on 5 trees at Little Qualicum Falls Prov. Park were affected	declining
Aspen leafminer, Phyllocnistis populiella	bCo	Cheakamus Lake	light defoliation to mature bCo over 200 ha	static
Fall webworm, Hyphantria cunea	deciduous trees and shrubs	Vancouver Region	occasional, scattered webbing on roadside	endemic
Poplar leaf blight, Venturia populina	bCo	Skagit Valley	2% discoloration of leaves for several kilometers along Skagit Rd.	endemic
Shot-hole disease, Coccomyces hiemalis	Ch	Fraser Valley	10% branch dieback on scattered trees	static
Western oak looper, Lambdina f. somniaria	gO	Saltspring Island and Victoria	no damage or larvae	endemic

*D-fir Douglas-fir
sP shore pine
wH western hemlock
aF amabilis fir
sS Sitka spruce
eS Engelmann spruce
wrC western red cedar
rA red alder
Arb arbutus
bCo black cottonwood
Ch Cherry
gO Garry oak

New Records of Occurrence and Distribution

Insect or Disease	Host	Remarks and Location
	Conifer hosts	
Balsam shoot borer, *Argyresthia* sp.	Grand fir	first collection from western *Abies* spp.
Blight on seedlings, *Rosellinia minor*	Engelmann spruce	new record in British Columbia on seedlings at Maple Ridge
Cypress bark moth, *Cydia cupressana*	Eastern white cedar	new record in British Columbia at Victoria
Dieback fungus, *Phacidium gaeumannii*	Douglas-fir	new host record at Hope
Dieback fungus, *Tympanis laricina*	Western white pine	new host record at Nanaimo
Eastern spruce gall adelgid, *Adelges abietis*	Sitka spruce	first collection of European species in British Columbia at Victoria
Epiphyte (leaf), *Epipolaeum* sp.	Western yew	new host record at Tofino
Epiphyte (bark), *Stigmina* sp.	Western hemlock	new host record at Courtenay
Epiphyte, *Verrucaria plumbaria*	Deodar cedar	new host record at Victoria
Fly speck fungus, *Leptopeltis* sp.	Yellow cedar	new record in British Columbia at Sooke
Gall midge, *Contarinia* n. sp.	Yellow cedar	new record in British Columbia at four sites on Vancouver Island and two in the Fraser Valley
Hyperparasitic fungus, *Aegerita fungicola*	Western hemlock	new host record at Parksville
Pine needle scale, *Chionaspis pinifoliae*	Grand fir	new host record for British Columbia at Sidney
Resin midge, *Cecidomyia* n. sp.	White spruce	new species collected on container stock at Duncan

Insect or Disease	Host	Remarks and Location
Resin fungus, *Claussenomyces olivaceus*	Grand fir	new host record at Sechelt
Saprophytic fungus, *Pithya vulgaris*	Atlas cedar	new host record associated with *Sirococcus strobilinus* on stressed trees in North Vancouver
Spruce bud scale, *Physokermes piceae*	Grand fir	new host record at Sidney
Western gall rust, *Endocronartium harknessii*	Jeffrey pine	new host record for British Columbia at Victoria
	Deciduous hosts	
Gall fungus, *Gloeosporium* sp.	Oak	new host record for British Columbia at Victoria
Gall midges, *Dasineura gleditchiae*	Honey-locust	first record for western Canada at Victoria
Leaf blight, *Phyllosticta* sp.	Horse-chestnut	new host record at Harrison Lake
Leaf blight, *Microstroma juglandis*	Walnut	new host record for British Columbia at North Pender Island
Leaf blight, *Taphrina* sp.	Plum	new host record for British Columbia at Saanichton
Leafminer, *Leucoptera laburnella*	Laburnum	new distribution record at Campbell River
Leaf spot, *Septoria aceris*	Vine maple	new host record for British Columbia at North Vancouver
Mycorrhizal mushroom, *Tricholoma populinum*	Soil and duff	new record at Victoria
Root rot, *Phytophthora cactorum*	Arbutus	new host record for British Columbia at Victoria

QUEEN CHARLOTTE ISLANDS

1987

L. Unger and A. Stewart

HEMLOCK PESTS

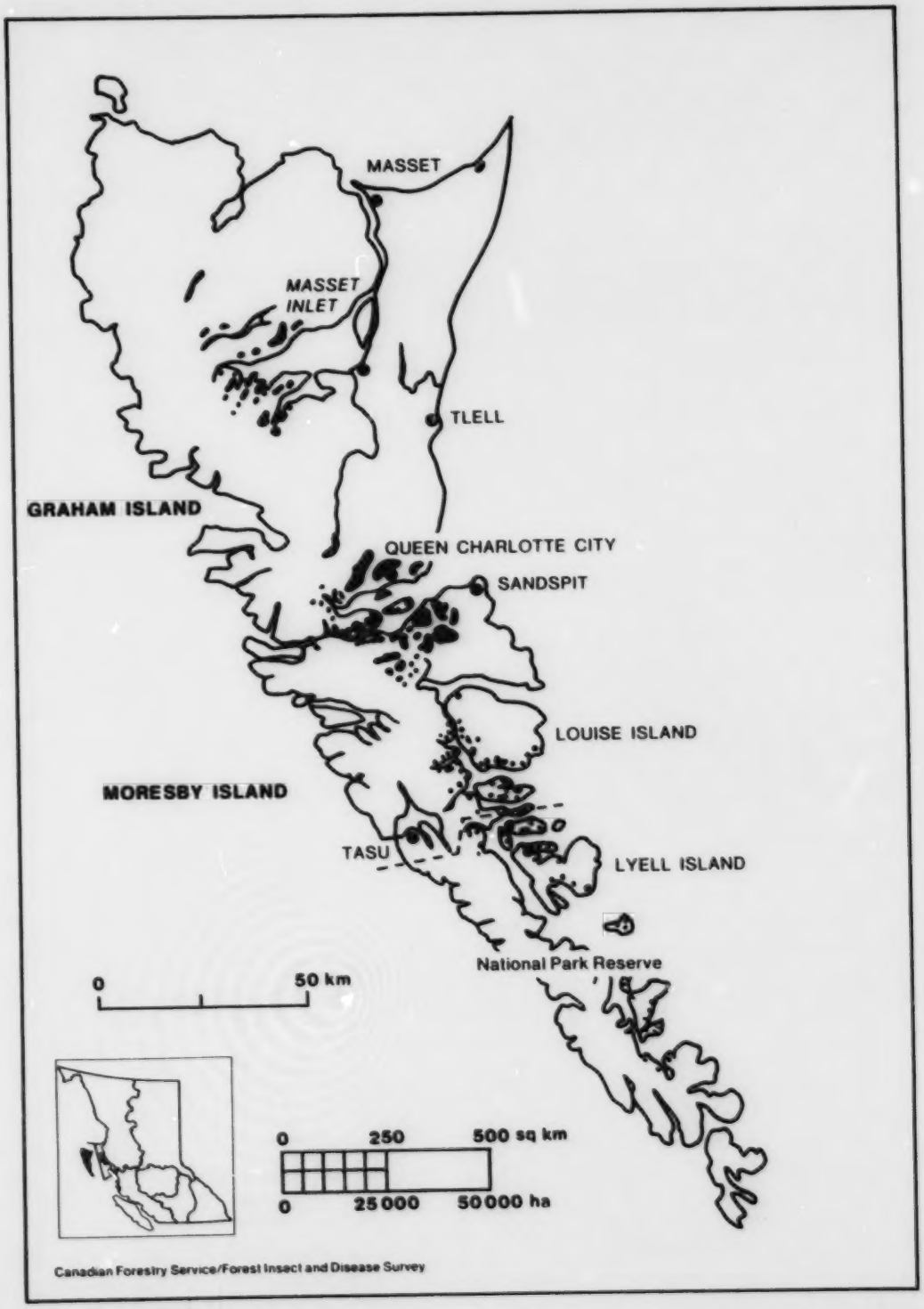
Hemlock sawfly
Neodiprion tsugae
Western blackheaded budworm
Acleris gloverana

In the third year of an outbreak on the Queen Charlotte Islands, defoliation of western hemlock by the hemlock sawfly and western blackheaded budworm was mapped over an estimated 14 110 ha, down from a high of 44 300 ha in 1986 (Table 1, Map 1). Most of the defoliation over approximately 9660 ha were on Graham Island, generally in the Skidegate Channel and Masset Inlet areas. Most of the remaining areas of defoliation, 4450 ha, were towards the north end of Moresby Island. A new area with severe defoliation of current growth by the budworm was found during ground surveys near Tow Hill. Western areas of both Graham and Moresby Islands and northern areas of Graham Island were not flown in 1987.

Table 1. Estimated areas and intensity of western hemlock defoliated by the western blackheaded budworm and hemlock sawfly on the Queen Charlotte Islands, 1985 - 1987.

Defoliation intensity	Area (ha) defoliated in 1987 by stand age			Area defoliated (ha)		
	<20 yrs.	20-100 yrs.	100+ yrs.	1987	1986	1985
Light	270	1 450	1 170	2 890	15 350	5 700
Moderate	2 650	3 530	2 450	8 630	22 800	19 100
Severe	460	990	1 140	2 590	6 150	3 800
TOTAL	3 380	5 970	4 760	14 110	44 300	28 600

Generally there has been a northerly shift of defoliation through the Queen Charlotte Islands during the course of the outbreak. Areas of the Moresby Archipelago which were severely defoliated in 1985-86 were either not defoliated in 1987 or were lightly or moderately defoliated in small patches.



Map 1. Areas where current defoliation by western blackheaded budworm and hemlock sawfly was detected during aerial surveys, 1987

In most areas defoliation was caused primarily by the hemlock sawfly. During larval sampling in July sawfly larvae outnumbered budworm larvae by average ratios of 1.4:1 through the Moresby Archipelago and 2.7:1 on Graham Island. The combination of sawfly feeding on the older foliage and budworm feeding on the new growth resulted in more intense defoliation and possible tree mortality and top-kill in some areas. Recovery of vigorous trees on good sites has also been observed, however, particularly where the damage was caused by only one of the insects rather than both.

Impact Assessment

In most of the 1987 aerial surveys, accumulated tree mortality due to feeding by one or both defoliators since 1985 was mapped by BCFS and industry personnel as a percentage of a currently or previously defoliated stand (Table 2). Of the accumulated 3670 ha mapped, 440 ha (12%) were in stands currently defoliated at light intensity, 920 ha (25%) in stands moderately defoliated, 810 ha (22%) in stands severely defoliated, and 1500 ha (41%) in stands with no defoliation in 1987. About 50 ha (1%) of the stands mapped with accumulated mortality were less than 20 years old, 1820 ha (50%) were from 20 to 100 years old and 1800 ha (49%) were over 100 years old.

Table 2. Area and average mortality of western hemlock caused by defoliation by hemlock sawfly and western blackheaded budworm, on the Queen Charlotte Islands, Vancouver Forest Region, 1985-1987.

Current defoliation intensity	Stand age	No. infestations	Area defoliated (ha)	No. infestations with mortality	Area containing mortality (ha)	Average mortality (%)
Light	<20	4	264	0	0	0
	20-100	29	1451	4	180	10
	100+	32	1177	1	260	20
Subtotal		65	2892	5	440	-
Moderate	<20	11	2657	1	50	80
	20-100	63	3529	12	570	15
	100+	48	2449	11	300	22
Subtotal		122	8635	24	920	-
Severe	<20	2	458	0	0	0
	20-100	22	995	4	60	50
	100+	10	1136	5	750	40
Subtotal		34	2589	9	810	-
None	<20	0	0	0	0	0
	20-100	26	1010	26	1010	25
	100+	13	490	13	490	15
Subtotal		39	1500	39	1500	-
TOTAL		260	15616	77	3670	-

The full impact of defoliation upon infested stands will be assessed when the infestation subsides. Ten stand impact plots established in 1985 will be monitored annually, as access permits, and cruise strips will be placed in representative stands to assess growth loss, top-kill and tree mortality.

Forecasts

Populations of the hemlock sawfly are expected to continue to decline with or shortly after those of the blackheaded budworm. In an attempt to assess the sawfly population, cocoons were recovered from foliage collected for budworm egg counts. Thresholds developed during a previous outbreak to relate the incidence of cocoons to anticipated defoliation were modified to reflect the current stage of the present outbreak (Table 3). The substantial but variable prepupal mortality, though not considered in determination of predictions, may contribute to a further drop in the intensity and extent of defoliation in 1988.

Table 3. Hemlock sawfly population and defoliation assessments for 1987 and predictions for defoliation in 1988 based on a modification of thresholds developed in a previous outbreak to relate cocoon incidence to expected defoliation. Vancouver Forest Region, 1987.

Location	1987 larval count[1]	1987 defoliation	Cocoon incidence[2]	Predicted 1988 defoliation[3]	Prepupal mortality[4]
BCFS					
Honna R. Spur 100	495	light	3.6	moderate	86
Honna R. Spur 182	1650	severe	3.3	moderate	65
Honna R. Spur 100	825	moderate	2.0	moderate	55
Honna R. Spur 1007	1275	severe	1.0	light	83
Collison Pt. (spaced)	-	none	0.2	none	100
Collison Pt. (unspaced)	-	none	0	none	-
Crown Forest					
Kagan Peninsula	-	severe	22.3	severe	42
Aliford Main	2850	severe	5.3	severe	76
South Bay Spur 40A	1360	severe	3.4	moderate	88
South Bay Spur 51	-	moderate	3.4	moderate	62
Skidegate Narrows N.	2400	severe	3.1	moderate	10
South Bay	-	light	1.3	light	70
Moresby Ridge	-	severe	0.6	none	58
South Bay Spur 60	690	severe	-	-	-
South Bay Spur 40	490	severe	-	-	-
West Main	20	none	0	none	-
Aerocamp Rd.	225	trace	0	none	-

Location	1987 larval count[1]	1987 defoliation	Cocoon incidence[2]	Predicted 1988 defoliation[3]	Prepupal mortality[4]
Macmillan Bloedel					
Ain R.	1150	severe	3.3	moderate	15
Begbie Bay	-	severe	2.7	moderate	15
Wathus Island	2050	severe	2.7	moderate	60
Buckley Cove	1500	severe	1.6	light	50
McClinton Bay	400	light	0.9	light	12
Louise Island	950	trace	0.6	none	31
Harrison Island	95	none	0.6	none	24
Dinan Bay	1000	severe	0.5	none	20
Datlamen Main	0	light	0.1	none	100
Western Forest Products					
Talunkwan I. Ridge	-	light	1.7	light	53
Sewell Inlet (mature)	600	trace	1.4	light	36
Sewell Inlet (immature)	175	trace	0.4	none	75
Ramsay Island	-	none	0.1	none	100
Forsyth Pt.	-	none	0	none	-
Naikoon Provincial Park					
Tow Hill	0	none	0.1	none	0

[1]Larval count - total no. larvae collected per standard 3-tree beating sample
[2]Cocoon incidence - average number of cocoons recovered per 50-cm branch length
[3]Predicted 1988 defoliation:
>5 cocoons - severe defoliation expected
2-5 cocoons - continuing defoliation, probably moderate
1-2 cocoons - continuing defoliation, probably light
<1 cocoon - no significant defoliation expected

[4]Prepupal mortality - percent of cocoons recovered which were parasitized and/or infected with a virus

The decline in the blackheaded budworm population is forecast to continue in 1988 in most areas, based on egg counts from foliage collected in October (Table 4). The average egg count was 11 per 50-cm branch, down from 18 in 1986, and 117 in 1985 at the peak of the outbreak. Severe defoliation by the blackheaded budworm is forecast at 1 location (3%), moderate at 3 (9%), trace to light at 24 (68%), and none at 7 locations (20%). A general northward trend in the distribution and intensity of defoliation by the blackheaded budworm is forecast to continue, with no further defoliation expected in the Moresby group south of the Louise Island and Sewell Inlet area, trace to light defoliation over northern Moresby Island, light to moderate defoliation in the southern Graham Island and Masset Inlet areas, and a pocket of severe defoliation continuing at Tow Hill on northern Graham Island. Although most of the moth flight had passed by the time foliage was collected, some adults were still flying so egg counts may be slightly conservative in some areas.

Table 4. Number of eggs and predicted defoliation of western hemlock by the western blackheaded budworm in the Queen Charlotte Islands. Vancouver Forest Region, 1987.

Location	Avg. no. eggs/50-cm branch 1985	1986	1987	Predicted defoliation 1988[1]
BCFS				
Honna R. west		28	53	Moderate
Honna R. east		23	32	Moderate
Honna R. west			26	Light
Honna R. west			23	Light
Honna R. west		24	15	Light
Honna R. east			10	Light
Collison Pt. (unspaced)			4	Trace
Collison Pt. (spaced)		1	1	Trace
Crown Forest				
North Moresby Ridge			13	Light
Aliford Main			10	Light
South Bay Spur 40		53	7	Light
South Bay Spur 60		66	4	Trace
Skidegate Narrows N.			4	Trace
Kagan Peninsula			4	Trace
South Bay Spur 40A			3	Trace
South Bay Spur 51			3	Trace
South Bay			3	Trace
West Main			1	Trace
Aerocamp Rd.			1	Trace
MacMillan Bloedel				
Harrison Island		32	29	Moderate
Wathus Island	35	4	12	Light
Buckley Cove			11	Light
Begbie (Shannon) Bay		31	10	Light
McClinton Bay			9	Light
Dinan Bay			7	Light
Datlamen Main			7	Light
Ain R.		19	3	Trace
Louise Island		27	<1	None
Western Forest Products				
Sewell Inlet (mature)	125	19	<1	None
Sewell Inlet (regen)		12	<1	"
Forsyth Pt.	135	6	<1	"
Talunkwan I. south	111	4	<1	"
Talunkwan I. ridge			<1	"
Ramsay I.	170	1	<1	"

Location	Avg. no. eggs/50-cm branch 1985	1986	1987	Predicted defoliation 1988[1]
Naikoon Provincial Park				
Tow Hill			73	Severe
Average	117[2]	18[2]	11	

1 <1 egg = no further defoliation expected
1-5 eggs = trace defoliation
6-26 eggs = light defoliation
27-59 eggs = moderate defoliation
60+ eggs = severe defoliation

[2]Average includes areas not assessed previously and not shown.

Sirococcus tip blight
Sirococcus strobilinus

Sirococcus tip blight severely infected the current growth of mountain hemlock on understory regeneration on a ridge 10 km southeast of Juskatla. These infections were the first record of this disease on mountain hemlock. Western hemlock regeneration in the same area was not infected. Although old spruce cones collected near Rennell Sound all bore pycnidia of Sirococcus tip blight, no significant foliar infections were noted in the area. Cones collected from infected areas transfer the inoculum into seedlots and can result in up to 30% germinant mortality.

Green velvet looper
Epirrita autumnata

During fall surveys large numbers of this moth were reported by loggers in mature western hemlock on a ridge about 10 km southeast of Juskatla. Examination of foliage on recently felled trees did not reveal any significant feeding damage. No significant numbers of this insect were collected during larval sampling in July at permanent sampling points on Graham Island and the northern portion of Moresby Island.

This insect can increase in numbers to the point where defoliation is significant; however, such outbreaks are generally localized in area and of short duration. Follow-up surveys in 1988 will help to clarify the significance of the observations.

Dwarf mistletoe
Arceuthobium tsugense

Hemlock dwarf mistletoe is a chronic and common parasite of western hemlock throughout the Queen Charlotte Islands, significantly reducing growth rates. Surveys to detect hyperparasites on mistletoe plant clusters in a heavily infected stand at Thurston Harbour were negative; hyperparasites have not been found in any previous mistletoe collections from the Queen Charlotte Islands. Occasionally found in mainland collections, the hyperparasites reduce seed production and parasitize the shoot portion; further survey efforts will be made. Maintenance of mistletoe-free buffer zones around clearcuts would minimize its spread into susceptible regeneration.

SPRUCE PESTS

Spruce aphid
Elatobium abietinum

After a mild winter, populations of the spruce aphid increased in 1987 following two years of declining numbers largely due to low winter temperatures. The population buildup has been greatest in coastal areas with scattered severe defoliation of older Sitka spruce foliage common on the eastern, southern and some northern coastal areas of Graham Island and on the north and east coasts of Moresby Island. During the main spring feeding period, primarily patches of current foliage were killed, resulting in totally defoliated branches, some dieback and possibly tree mortality. Most of the older foliage previously had been destroyed during an extended fall feeding period in 1986 and during an unusually warm period during late winter.

The incidence and intensity of feeding by the spruce aphid were assessed in two representative coastal plantations (Table 5).

Table 5. Incidence and intensity of feeding by the spruce aphid on Sitka spruce in coastal plantations on the Queen Charlotte Islands. Vancouver Forest Region, 1987.

Location	Stand age	No. trees assessed	Incidence of feeding/defoliation by intensity							
			New (1987) foliage[1]				Older foliage			
			none	<5%	5-10%	11-25%	<10%	10-30%	31-80%	81+%
N. Moresby	4	50	10	40	40	10	0	8	24	68
Miller Creek (Graham I.	10	25	44	48	8	0	52	0	36	12

[1]Differing defoliation categories are used for old and new foliage because of the nature of aphid feeding. Before new foliage is fed upon, all of the old foliage has been destroyed; therefore, the impact of feeding on the new foliage occurs at a much lower level of feeding intensity.

In the youngest plantation on the north coast of Moresby Island, 68% of the trees had lost between 80 and 100% of their pre-1987 foliage, although in most cases, less than 10% of the current foliage had been fed upon. The 50 trees assessed at this location were tagged for annual assessment of defoliation and impact. In an older plantation near Miller Creek on Graham Island, none of the trees had more than 10% of the current foliage fed upon. Feeding on the pre-1987 foliage was generally less intense in the older plantation than in the younger plantation. An increasing aphid population probably takes longer to reach a comparable severity of feeding on older saplings because of the greater amount of older foliage to be fed upon. A second consecutive mild winter could lead to further expansion of the aphid population in 1988, with the greatest increase in feeding intensity probably recorded in the 1987 and earlier foliage of the older trees.

In a mature Sitka spruce stand near Miller Creek, trees marked in a 1982 impact assessment plot were re-examined. The accumulated mortality of these trees due to defoliation by the spruce aphid remained at the 1985 level of 67%, compared to 20% in 1983 when measurements followed six consecutive years of defoliation. All the marked trees were alive in 1982. Cruise strips placed in the same area included younger trees and recorded 22% accumulated stand mortality in 1982 followed by 42% in 1985. Sustained severe feeding by the spruce aphid in the current outbreak will probably cause further mortality in coastal mature stands.

Spruce budworms *Choristoneura* spp.

As part of a province-wide pheromone trapping study to gain information on the distribution of four species of spruce budworms, six pheromone-baited plastic container traps ("Universal") were deployed near the Yakoun River in a mature Sitka spruce stand with a minor component of western hemlock. Three of the traps baited to attract *C. orae*[1] did not catch any moths. The other two traps (one was not recovered) baited to attract *C. fumiferana*, *C. occidentalis*, and *C. biennis*[2] attracted five and eight moths, respectively. These numbers probably represent catches indicative of an endemic population since no defoliation was noted in the area. Detailed examination at the Pacific Forestry Centre revealed that one of the moths had spines on the aedeagus characteristic of *C. fumiferana*, which had never before been identified on the Queen Charlotte Islands. The rest of the moths were assumed to be *C. biennis*.

[1]baited with trans-11-tetradecenyl + cis-11-tetradecenyl + trans-11-tetradecenol at 5%
[2]baited with trans-11-tetradecenal + cis-11-tetradecenal at 5%

A parasitic microfungus *Sarea difformis*

The causal agent of branch cankers and stem galls common on semimature Sitka spruce near the Tlell River was identified as *Sarea difformis*, the first record of this disease on the Queen Charlotte Islands. This fungus has been isolated from the sapwood and heartwood of infected trees elsewhere in British Columbia, suggesting a role in the degeneration and/or decay of infected trees.

CEDAR PESTS

Yellow cypress rust
Gymnosporangium nootkatense

This rust was collected for the first time on yellow cedar on the Queen Charlotte Islands at trace levels near Rennell Sound. A previous collection had been made from a rosaceous alternate host, Pacific crabapple, near Masset in 1956. The current collection confirms the occurrence of the telial stage in yellow cedar on the Queen Charlotte Islands. Although infections of this disease can be damaging to the alternate hosts, the impact on yellow cedar is expected to remain minimal.

SPECIAL SURVEYS

Cone and seed pests

At Mayer Lake Provincial Park 30% of the lodgepole pine cones collected were infested by the lodgepole pine cone borer, *Eucosma rescissoriana*, the first collection of this insect from the Queen Charlotte Islands. In the infested cones an average of 84% (range 43-100%) of seeds were destroyed per cone.

Collections of Sitka spruce cones from Copper Bay and Rockfish Harbour did not contain damaging insects. However, 5% of the cones collected at Lawnhill Point and Miller Creek had 60 and 67%, respectively, of seeds destroyed by the spruce cone maggot, *Lasiomma anthracinum*. Collections at both locations were negative in 1986.

No damaging insects were found in yellow cedar cones collected from two locations in the Rennell Sound area.

Pinewood nematode
Bursaphelenchus xylophilus

Surveys continued in 1987 to evaluate the occurrence of the pinewood nematode in host trees and suspected insect vectors across Canada. Although surveys to date suggest the nematode is of minor significance in B.C., in Japan it has caused widespread mortality of pine. Scandinavian countries have placed embargoes on some wood products, particularly chips for pulp, from countries where the nematode occurs, including Canada, to protect their forests from this perceived threat.

A collection from a dying lodgepole pine at Mayer Lake Provincial Park, infested with secondary bark beetles and wood borers, did contain nematodes which were not *B. xylophilus*, but native bacterial or insect-associated nematodes. Further collections from symptomatic trees will be made in 1988.

Gypsy moth
Lymantria dispar

Pheromone-baited sticky traps to detect any introduction of the gypsy moth to the Queen Charlotte Islands in 1987 were placed at the Canadian Armed Forces Base in Masset and at Skidegate Ferry Terminal; all were negative, as were numerous traps placed throughout the Islands by the B.C. Forest Service. Although no moths have been caught after three years of trapping on the Queen Charlotte Islands, continued monitoring is essential for quick detection and eradication of any moths introduced from civilian or military traffic originating or passing through eastern North American infestations. Efforts are underway to eradicate localized new populations of this defoliator on Vancouver Island, in the Fraser Valley and in the Okanagan.

MINOR PESTS

Table 6. Collections and records of other pests on the Queen Charlotte islands, 1987.

Agent	Host	Location	Remarks
Drought	wH sS	Graham I.	caused wilting of 1987 shoots of exposed young trees
Gall midge *Contarinia* n. sp.	yC	coastal B.C.	negative on Q.C.I.; found through rest of coastal host range
Gelechiid defoliator, *Eucalantica polita*	salal	Datlamen Road	damage to foliage locally common at light intensity
Giant conifer aphid *Cinara* sp.	sP	Mayer Lake	caused yellowing of current foliage on 10% of trees
Large-spored-spruce--Labrador tea rust, *Chrysomyxa ledicola*	sS	Honna R.	current foliage lightly infected
Sooty mould *Asteridiella pitya*	wY	Rennell Sound	caused sooty splotches on foliage, especially underside, first record from Q.C.I.
Spruce gall adelgid *Pineus* sp.	sS	N. Morseby	light gall swelling on current foliage in a four-year-old plantation
Spruce needle cast *Lophodermium piceae*	sS	Rennell Sound	infected two-year-old and older foliage at trace intensity
Squirrel damage	sP	Graham I.	causing scattered branch and stem mortality, most common in boggy areas.

[1] wH - western hemlock sS - Sitka spruce yC - yellow cedar sP - shore pine
wY - western yew